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## **REMARKS**

In the Action mailed October 8, 2003, claims 1-3, 5, 7, 10, and 14-18 were rejected for obviousness-type double patenting over claims 1-10 of U.S. Patent 6,176,947.

Claims 1-4 and 16-18 were rejected under 35 U.S.C. § 103 as being unpatentable over USP 4879096 to Naton.

Claims 1-4, 10, and 16-18 were rejected under 35 U.S.C. § 103 as being unpatentable over USP 5520752 to Lucey.

Claims 1-2, 5, 7, 9-13 were rejected under 35 U.S.C. § 103 as being unpatentable over USP 5766776 to Buresch.

Claims 1-2 and 10-11 were rejected under 35 U.S. C. § 103 as being unpatentable over JP 02179388, JP 06269981, JP 06269983, or JP 06269982.

Claims 1-2 and 7-8 were rejected under 35 U.S.C. § 103 as being unpatentable over JP 07284983 or JP 08001372.

Claims 1-11 and 14-18 were rejected under 35 U.S.C. § 103 as being unpatentable over JP 2000061685.

Claims 1-2 and 14-18 were rejected under 35 U.S.C. § 103 as being unpatentable over JP 08206874.

Claims 1-2, 7,9,14, and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over WO 9534401.

Claims 1-3 and 16-18 were rejected under 35 U.S.C. § 103 as being unpatentable over JP 08132277.

Claims 1-5 and 14 were rejected under 35 U.S.C. § 103 as being unpatentable over JP 11077368.

In view of the amendments and remarks set forth herein, it is respectfully submitted that all claims 1-6 and 10-20 are in condition for allowance.

### **A. Claims 1-4 And 16-18 Are Patentable Over U.S. Patent 4,879,096 To Naton.**

In support of this and all other § 103 rejections the Examiner asserted:

The cited reference(s) disclose(s) the features including the claimed solder compositions. An obviousness rejection based on similarity in chemical structure and function entails the motivation of one skilled in the art to make a claimed compound, in the expectation that compounds similar in structure will have similar properties. In re Gyurik, 596 F.2d 1012, 1018, 201 USPQ 552,

557 (CCPA 1979); See *In re May*, 574 F.2d 1082, 1094, 197 USPQ 601, 611 (CCPA 1978) and *In re Hoch*, 57 CCPA 1292, 1296, 428 F.2d 1341, 1344, 166 USPQ 406, 409 (1970). Therefore, the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have selected the overlapping portion of the subject matter disclosed by the reference. Overlapping ranges have been held to be a prima facie case of obviousness. See *In re Malagari*, 499 F.2d 1297, 1303, 182 USPQ 549, 553 (CCPA 1974).

Cited references are silent about the limitation as set forth in claim 18. However, the instant solder compositions are overlapped by the cited references; consequently, the properties as recited in the instant claims would have inherently possessed by the teachings of the cited references. Therefore, the burden is on the applicant to prove that the product of the prior art does not necessarily or inherently possess characteristics attributed to the claimed product. *In re Spade*, 911 F.2d 705, 708, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990) and *In re Best*, 195 USPQ, 430 and MPEP § 2112.01.

Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established, *In re Best*, 195 USPQ 430, 433 (CCPA 1977). 'When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not.' *In re Spada*, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. *In re Best*, 195 USPQ 430, 433 (CCPA 1977).

Pages 4-5 of the October 8, 2003 Office Action.

Before addressing each of the Examiner's specific rejections, it is important to note an overall deficiency associated with the Examiner's many and varied rejections. All of the pending claims recite specific alloys, each formed from a particular combination of elements, and each element being in a certain proportion to other elements in the claimed alloy. The structure, properties, and correlation between the metallurgical structure and properties of each claimed alloy are not obvious. The dynamics of the volumetric ratio of metallurgical phases and the grain size and distribution sensitively depend on the absence or presence of a specific element and its concentration. These parameters can not be arrived at by picking and choosing from a large assortment of patents and publications in the art. Simply put, the specific aspects of the pending claims are not taught by the prior art.

Specifically, with regard to the first ground of rejection, the Examiner asserted that claims 1-4 and 16-18 were obvious in view of the '096 patent to Naton, and specifically, its abstract. The abstract of the '096 patent describes lead-free solders containing about 0.05% to about 3% by weight silver, about 0.5% to about 6% by

weight copper, about 0.1% to about 3% by weight bismuth, and about 88% to about 99.35% by weight tin.

Claim 1 has been amended to more clearly recite the claimed alloy compositions. Claim 1 now recites that each of the alloy compositions (i) through (vii) **consists essentially of** the various recited elements. As the Examiner will appreciate, this terminology limits the scope of the claim to the specified materials and to those that do not materially affect the basic and novel characteristics of the claim. In re Herz, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976).

The alloy (i) recited by claim 1 recites a specific combination of proportions of Sn, Cu, and Bi. In contrast, the '096 patent to Naton teaches the additional incorporation of silver. The addition of silver to the particular combination of proportions of Sn, Cu, and Bi, would tend to impart particular undesirable properties to the resulting alloy. Amended claim 1 excludes this additional element from alloy (i)

Alloy (ii) of claim 1 recites a specific combination of particular proportions of Sn, Cu, and Sb. The cited abstract of the '096 patent to Naton entirely fails to teach alloy (ii) of claim 1. Instead, Naton teaches the incorporation of additional elements silver and bismuth. Amended claim 1 excludes these additional elements from alloy (ii).

Alloy (iii) of claim 1 has been cancelled. And so, its rejection is moot.

Alloy (iv) of claim 1 recites a particular combination of proportions of Sn, Cu, and Ag. Again, the '096 patent to Naton describes an entirely different alloy, one which includes not only different proportions of these components, but also requires bismuth which is not called for in alloy (iv). Actually, amended claim 1 now excludes bismuth from the claimed subject matter.

Alloy (v) of claim 1 consists essentially of particular proportions of Sn and one or both of Ni and Co. The abstract of the '096 patent entirely fails to teach the incorporation of either Ni or Co. In addition, the '096 patent requires silver, copper, and bismuth. Amended claim 1 excludes these elements.

Alloy (vi) of claim 1 recites an alloy consisting essentially of particular proportions of Sn, Bi, and optionally Sb. The abstract of the '096 patent teaches the additional incorporation of silver and copper. Amended claim 1 excludes silver and copper. Clearly, the '096 patent is not relevant.

Alloy (vii) of claim 1 recites an alloy consisting essentially of certain proportions of Sn, Cu, and Bi. The abstract of the '096 patent fails to teach these proportions, and

additionally requires silver. Amended claim 1 excludes silver from the composition of alloy (vii).

Since amended claim 1 is patentable over the '096 patent to Naton, so too are dependent claims 2-4 and 16-18 which contain all of the recitations of claim 1.

**B. Claims 1-4, 10 And 16-18 Are Patentable Over U.S. Patent 5,520,752 To Lucey.**

The Examiner cited the '752 patent to Lucey, and specifically, claim 1 of the '752 patent, as teaching the subject matter of claims 1-4, 10 and 16-18. Applicant submits that such rejection is misplaced, particularly in view of the amendments to claim 1.

Claim 1 of the '752 patent relied upon by the Examiner, teaches four (4) alloys - Sn-Ag-In, Sn-Ag-In-Bi, Sn-Ag-Bi, and Sn-Ag-Bi-Cu.

Alloy (i) of claim 1 of the present application in contrast, recites particular proportions of an alloy of Sn, Cu, and Bi, and in particular proportions. The '752 patent fails to teach alloy (i). Amended claim 1 excludes additional elements as previously explained herein.

Alloy (ii) of claim 1 recites an alloy of Sn, Cu, and Sb. The '752 patent fails to teach this particular alloy.

Alloy (iii) of claim 1 has been cancelled.

Alloy (iv) of claim 1 recites certain proportions of Sn, Cu, and Ag. Alloy (iv) specifically recites that it consists essentially of these elements, and so, excludes the additional elements taught in claim 1 of the '752 patent.

Alloy (v) recites particular proportions of Sn, and Ni and/or Co. Claim 1 of the '752 patent entirely fails to teach this combination of elements.

Alloy (vi) recites specific proportions of Sn, Bi, and optionally Sb. Again, claim 1 of the '752 patent fails to teach this combination. The amendments to claim 1 exclude the incorporation of additional elements as explained herein.

Alloy (vii) recites particular proportions of Sn, Cu, and Bi. Alloy (vii) is recited as consisting essentially of these elements and so, excludes others such as those taught in claim 1 of the '752 patent.

For at least these reasons, claim 1 as amended, is patentable over the '752 patent to Lucey. Since claim 1 is patentable, so too are claims 2-4, 10, and 16-18 dependent therefrom.

**C. Claims 1-2, 5, 7, And 9-13 Are Patentable Over U.S. Patent 5,766,776 To Buresch.**

The Examiner contended that the '776 patent to Buresch and specifically, claim 6 of that patent, teaches the subject matter of the rejected claims. Applicant submits that in view of the amendments and remarks set forth herein, such rejection must now be withdrawn.

Claim 6 of the '776 patent recites an alloy containing tin and cobalt and one or more elements selected from the group consisting of antimony, silver, nickel, zinc, copper, phosphorous, selenium, tellurium, aluminum, iron, and tin. Actually, the '776 patent relates to materials for surface coatings on copper wire or strips. The compositions of the '776 patent are not intended for electronic interconnecting applications that must meet harsh temperature and mechanical requirements as are the presently pending alloys.

Alloy (i) of claim 1 of the present application recites particular proportions of Sn, Cu, and Bi. The '776 patent fails to teach these aspects. Moreover, alloy (i) of claim 1 excludes the addition of other elements that would affect the basic and material properties of the resulting alloy.

Alloy (ii) recites an alloy of particular proportions of Sn, Cu, and Sb. Again, the '776 patent entirely fails to teach the combination of these particular elements and proportions. Furthermore, alloy (ii) is recited as excluding other elements as noted.

Alloy (iii) has been cancelled.

Alloy (iv) recites specific proportions of Sn, Cu, and Ag. The '776 patent entirely fails to teach this combination of proportions of elements. Furthermore, alloy (iv) excludes other elements as previously noted.

Alloy (v) recites particular proportions of Sn and one or both of Ni, and Co. Claim 6 of the '776 patent entirely fails to teach this combination. And, alloy (v) is recited as specifically excluding other elements as noted.

Alloy (vi) recites particular proportions of Sn, Bi, and optionally Sb. Claim 6 of the '776 patent fails to teach these aspects. And, the alloy (vi) excludes additional elements as noted herein.

Alloy (vii) recites specific proportions of Sn, Cu, and Bi, and, as noted, excludes the addition of other elements. Claim 6 of the '776 patent entirely fails to teach these

aspects.

Since claim 1 is patentable over the limited disclosure of claim 6 of the '776 patent, so too are claims 2, 5, and 10-13 since each claim contains all of the recitations of amended claim 1. Claims 7 and 9 have been cancelled and so, their rejection is moot.

**D. Claims 1-2 And 10-11 Are Patentable Over JP 02179388, JP 06269981, JP 06269983, Or JP 06269982.**

The Examiner argued that each of the abstracts of these Japanese patent documents teaches the subject matter of claims 1-2 and 10-11. Applicant submits that in view of the amendments and remarks set forth herein, the rejection must be withdrawn.

The '388 JP Abstract teaches a solder containing Ag, Sn, Cu, In, and/or Ga, Fe, and/or Ni. The '981 JP Abstract teaches a solder containing Ag, Sn, Cu, and Pd. The '983 JP Abstract teaches a solder containing As, Sn, Cu, Pd, Fe, Co and/or Ni. The '982 JP Abstract teaches a solder containing Ag, Sn, Cu, Pd, In and/or Ga. The disclosures of these abstracts all relate to Sn-Ag-Cu-In or Sn-Ag-Cu-Pd systems which exhibit very different metallurgical structures and properties as compared to the alloys recited in the pending claims.

Claim 1 of the present application recites alloy (i) as consisting essentially of particular proportions of Sn, Cu, and Bi. None of the cited JP Abstracts teach this unique alloy. Moreover, alloy (i) excludes other elements that affect the basic and material properties of the resulting alloy.

Alloy (ii) of claim 1 recites particular proportions of Sn, Cu, and Sb. None of the cited JP Abstracts teach this specific alloy. Moreover, alloy (ii) is recited as excluding other elements as previously noted.

The recitation for alloy (iii) in claim 1 has been cancelled. Accordingly, the rejection and its application to the pending claims is moot.

Alloy (iv) recites a specific combination of Sn, Cu, and Ag, each in specific proportions. None of the cited JP Abstracts teach this unique alloy. Moreover, alloy (iv) is recited as excluding other elements as explained herein.

Alloy (v) recites particular proportions of Sn, Ni, and/or Co. And, this alloy is recited as excluding other elements as noted herein. None of the cited JP Abstracts teach this specified alloy.

Alloy (vi) recites particular proportions of Sn, Bi, and optionally Sb, and recites the exclusion of additional elements as recited herein. None of the cited JP Abstracts teaches this specific alloy composition.

Alloy (vii) recites particular proportions of Sn, Cu, and Bi. Alloy (vii) is recited as excluding additional elements as noted. None of the cited JP Abstracts teach or describe this particular alloy.

For at least these reasons, each of claims 1-2 and 10-11 are patentable over the limited teachings of the Abstracts of JP '388, JP '981, JP '983, and JP '982.

**E. Claims 1-2 And 7-8 Are Patentable Over JP 07284983 And JP 08001372.**

The Examiner cited the abstracts of each of the JP '983 and '372 patent documents. However, upon closer review it will be appreciated that these fail to teach the subject matter of the noted claims.

The '983 JP Abstract teaches a solder containing Sn, Sb, and Ag. The '372 JP Abstract teaches a solder containing Sn, Sb, and Ag.

Alloy (i) of claim 1 of the present application recites particular proportions of Sn, Cu, and Bi, and recites the exclusion of other elements that would affect the basic and material properties of the resulting alloy. Clearly, neither of the cited JP Abstracts teach this particular alloy.

Alloy (ii) of claim 1 recites a specific combination of Sn, Cu, and Sb, in particular proportions. Alloy (ii) is also recited as excluding other elements as previously noted. Neither of the cited JP '983 or JP '372 Abstracts teach this particular alloy.

Alloy (iii) has been cancelled from claim 1, and so, this aspect of the rejection is moot.

Alloy (iv) recites particular proportions of Sn, Cu, and Ag, and excludes other elements, as noted. Neither of the cited JP Abstracts teach this particular alloy composition.

Alloy (v) recites particular proportions of Sn, Ni, and/or Co, and excludes other elements as previously noted. Neither of the JP Abstracts teach this subject matter.

Alloy (vi) calls for particular proportions of Sn, Bi, and optionally Sb; and excludes other elements as noted. Neither of the cited JP Abstracts teach this alloy.

Alloy (vii) recites a specific combination of Sn, Cu, and Bi, each in particular proportions, and excludes other elements as previously noted. Neither of the '983 JP



Abstract nor the '372 JP Abstract teach this alloy composition.

For at least these reasons, claims 1-2 are patentable over the Abstracts of JP '983 and JP '372 documents. Claims 7-8 have been cancelled and so their rejection is moot.

**F. Claims 1-11 And 14-18 Are Patentable Over JP 2000061685.**

The Examiner asserted that the Abstract of the JP '685 document teaches the subject matter of these claims. Applicant submits that the rejection be withdrawn.

The Abstract of the JP '685 document describes a solder containing Na and Sn, with optional elements Pb, In, Bi, Ge, Sb, Cu, Zn, and/or Ag. This entirely fails to teach the particular alloy composition recited in the pending claims. The JP '685 document has no relevancy to the pending claims.

Alloy (i) of claim 1 recites particular proportions of Sn, Cu, and Bi; and excludes the addition of other elements as previously noted. The JP '685 Abstract entirely fails to teach this particular alloy.

Alloy (ii) of claim 1 recites particular proportions of Sn, Cu, and Sb; and excludes other elements as noted. The JP '685 Abstract entirely fails to teach this composition.

Alloy (iii) of claim 1 has been cancelled as previously noted.

Alloy (iv) of claim 1 recites a specific combination of Sn, Cu, and Ag, each in particular proportions. The JP '685 Abstract entirely fails to teach this subject matter.

Alloy (v) of claim 1 recites certain proportions of Sn, Ni and/or Co; and excludes the addition of other elements. The JP '685 Abstract fails to teach these aspects.

Alloy (vi) of claim 1 recites particular proportions of Sn, Bi, and optionally Sb; and excludes the addition of other elements. The JP '685 Abstract fails to teach this alloy.

Alloy (vii) of claim 1 recites particular proportions of Sn, Cu, and Bi, and excludes the addition of other elements. Clearly, the JP '685 Abstract fails to teach this alloy.

Since claim 1 is patentable over the limited description of the Abstract of the '685 JP document, then so too are claims 2-6, 10-11 and 14-18 since each of these claims is dependent from claim 1. Claims 7-9 have been cancelled so their rejection is moot.

**G. Claims 1-2 And 14-18 Are Patentable Over JP 08206874.**

The Examiner cited the Abstract of the '874 JP document and contended that

this teaches the subject matter of the noted claims.

The Abstract of the '874 JP document fails to teach or describe the subject matter of the pending claims. The '874 JP document describes a solder containing Sn, Ag, Bi and/or In, and optionally, Cu, and/or Zn, or Sb, Bi, and/or In, and optionally Cu and/or Zn. These alloys are not a Sn-Cu-Bi system as recited alloys (i) and (vii) in claim 1 of the present application. Instead, the alloys disclosed in the Abstract of the JP '874 document apply to lower temperature applications and are not suitable for the end-use applications intended for the claimed alloys of the present application.

Alloy (i) of claim 1 recites particular proportions of Sn, Cu, and Bi; and excludes the addition of other elements as previously noted. The JP '874 Abstract entirely fails to teach this particular alloy.

Alloy (ii) of claim 1 recites particular proportions of Sn, Cu, and Sb; and excludes other elements as noted. The JP '874 Abstract entirely fails to teach this composition.

Alloy (iii) of claim 1 has been cancelled.

Alloy (iv) of claim 1 recites particular proportions of Sn, Cu, and Ag; and excludes the addition of other elements as noted. The JP '874 Abstract fails to teach this particular composition.

Alloy (v) of claim 1 recites certain proportions of Sn, Ni and/or Co; and excludes the addition of other elements. The JP '874 Abstract fails to teach these aspects.

Alloy (vi) of claim 1 recites particular proportions of Sn, Bi, and optionally Sb; and excludes the addition of other elements. The JP '874 Abstract fails to teach this alloy.

Alloy (vii) of claim 1 recites particular proportions of Sn, Cu, and Bi, and excludes the addition of other elements. Clearly, the JP '874 Abstract fails to teach this alloy.

Since claim 1 is patentable over the limited description of the Abstract of the '874 JP document, then so too are claims 2 and 14-18 since each of these claims is dependent from claim 1.

#### **H. Claims 1-2, 7, 9, 14, And 15 Are Patentable Over WO 9534401.**

The Examiner contended that the Abstract of the WO '401 document teaches the subject matter of the noted claims. Applicant submits that in view of the amendments and remarks set forth herein, the rejection must be withdrawn.

The Abstract of the WO '401 document describes a solder comprising Si, optionally Ag, optionally Sb, optionally Bi, Sn, optionally Pb, and optionally Ca.

Alloy (i) of claim 1 recites particular proportions of Sn, Cu, and Bi; and excludes the addition of other elements as previously noted. The WO '401 Abstract entirely fails to teach this particular alloy.

Alloy (ii) of claim 1 recites particular proportions of Sn, Cu, and Sb; and excludes other elements as noted. The WO '401 Abstract entirely fails to teach this composition.

Alloy (iii) of claim 1 has been cancelled as previously noted.

Alloy (iv) of claim 1 recites particular proportions of Sn, Cu, and Ag; and excludes the addition of other elements as noted. The WO '401 Abstract fails to teach this particular composition.

Alloy (v) of claim 1 recites certain proportions of Sn, Ni and/or Co; and excludes the addition of other elements. The WO '401 Abstract fails to teach these aspects.

Alloy (vi) of claim 1 recites particular proportions of Sn, Bi, and optionally Sb; and excludes the addition of other elements. The WO '401 Abstract fails to teach this alloy.

Alloy (vii) of claim 1 recites particular proportions of Sn, Cu, and Bi, and excludes the addition of other elements. Clearly, the WO '401 Abstract fails to teach this alloy.

Since claim 1 is patentable over the limited description of the Abstract of the WO '401 document, then so too are claims 2, 14, and 15 since each of these claims is dependent from claim 1. Claims 7-9 have been cancelled, so their rejection is moot.

#### **I. Claims 1-5 And 14 Are Patentable Over JP 11077368.**

The Examiner rejected these claims by asserting they were obvious in view of the Abstract of the JP '368 document. Applicant submits that upon further review, the Examiner will appreciate that the present rejection must now be withdrawn.

The Abstract of the JP '368 document describes a solder containing Sn, Sb, Cu, Bi, and In. These solders are entirely separate and distinct from the presently claimed alloys.

Alloy (i) of claim 1 recites particular proportions of Sn, Cu, and Bi; and excludes the addition of other elements as previously noted. The JP '368 Abstract entirely fails to teach this particular alloy.

Alloy (ii) of claim 1 recites particular proportions of Sn, Cu, and Sb; and excludes other elements as noted. The JP '368 Abstract entirely fails to teach this composition.

Alloy (iii) of claim 1 has been cancelled.

Alloy (iv) of claim 1 recites particular proportions of Sn, Cu, and Ag; and

excludes the addition of other elements as noted. The JP '368 Abstract fails to teach this particular composition.

Alloy (v) of claim 1 recites certain proportions of Sn, Ni and/or Co; and excludes the addition of other elements. The JP '368 Abstract fails to teach these aspects.

Alloy (vi) of claim 1 recites particular proportions of Sn, Bi, and optionally Sb; and excludes the addition of other elements. The JP '368 Abstract fails to teach this alloy.

Alloy (vii) of claim 1 recites particular proportions of Sn, Cu, and Bi, and excludes the addition of other elements. Clearly, the JP '368 Abstract fails to teach this alloy.

Since claim 1 is patentable over the limited description of the Abstract of the JP '277 document, then so too are claims 2-5 and 14 since each of these claims is dependent from claim 1.

#### **J. Obviousness-Type Double Patenting Rejection Has Been Remedied.**

The Examiner rejected claims 1-3, 5, 7, 10, and 14-18 for alleged obviousness-type double patenting based upon claims 1-10 of U.S. Patent 6,176,947.

Although Applicant disagrees with the Examiner's view, in order to expedite prosecution of the present application, Applicant hereby submits a Terminal Disclaimer. Accordingly, this ground of rejection has been overcome.

#### **K. New Claims 19 and 20.**

Applicant presents new claims 19 and 20 which recite a very specific Sn-Ag-Sb alloy having improved strength and fatigue life. It has been surprisingly discovered that the physical properties, i.e., strength and fatigue life, of this alloy significantly improved and were maximized at a Sb content of 1.5-2.0%. For example, Sn-3.5% Ag-1.5% Sb has a shear strength of 51 MPa, tensile strength of 57 MPa, and a fatigue life of 16,424 cycles. In contrast, Sn-Ag exhibits a shear strength of 30 MPa, tensile strength of 35 MPa, and a fatigue life of 4,186 cycles. As Sb exceeds 5%, the properties of the resulting alloy drastically deteriorate. Moreover, as compared to a lead-containing solder counterpart, such as Sn-88% Pb-2% Ag, the alloy recited in claim 19 provides significantly superior performance to thereby serve as a lead-free compound.

**L. Conclusion.**

In view of the noted amendments, remarks, and Terminal Disclaimer, all claims 1-6 and 10-20 are submitted to be in condition for allowance.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he/she is hereby authorized to telephone Mark E. Bandy, at (216) 861-5582.

Respectfully submitted,

FAY, SHARPE, FAGAN,  
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December 18, 2003  
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